

## ***Interactive comment on “Variability, timescales, and non-linearity in climate responses to black carbon emissions” by Yang Yang et al.***

**Anonymous Referee #2**

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This study investigated the regional climate responses, non-linearity, and short-term transient responses to BC emission. The topic is of interest and the method scientifically sounds. I have a few comments: Major comments: 1) There is no model evaluation in this study. How does the model in terms of the aerosol species or climate variables? Some statistical evaluations are useful to warrant the confidence in interpreting the model results. 2) The authors mainly analyzed the results from the annual scale. Are there any substantial differences in a finer temporal scale, i.e., daily or monthly or seasonal? Minor comments: 2) Line 283: due to their 30 times larger: how to get the value of 30? 3) Figures 4-7: The captions need to be revised to explain the meaning of the dots. In Figure 2, it says that “The dotted areas in left panels indicate statistical significance with 95% confidence from a two-tailed Student’s t test.” Probably the dots

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in figures 4-7 share the same meaning. Please clarify. 4) Page 10, Line 194: Both mass and number of BC 5) Line 273-274: from Figure 3, we can see some substantial changes in the south hemisphere. What does this mean? Were the emissions scaled in the south hemisphere as well? 6) Line 446-447: Large scale surface temperature from current-day BC emissions is statistically indistinguishable from zero. The authors’ statement is based on global scale. Since the variability is large, are there any features (i.e., larger change in some areas) in different locations? 7) Line 522: BC direct radiative effects and snow/ice-albedo forcings have much larger signal to noise ratios: Could you please explain a bit more what the larger signal to noise ratio mean?

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